

REMARKS

1. Appendix A

Appendix A following Remarks section of the present Office Action Response is a graphical illustration of the hydrogen storage material present Application along with graphical illustrations of the prior art cited by the Examiner. The figures depicted in Appendix A are meant to assist the Examiner by illustrating the differences between the cited prior art and the present application.

1. Amended Claim

Claim 1 has been amended. No new matter has been added to claim 1 as claim 1 was amended to add antecedent basis.

2. Rejection of Claims 1-2, 4-5, 13-15, and 17-22 under 35 U.S.C. 102 (b) over Welter (US 4,613,362)

Applicants traverse the Examiner's rejection over Welter, because Welter does not teach a continuous or semi-continuous layer of catalytic material on the surface of the hydrogen storage alloy layer as required by Applicant's claim 1.

In contrast to Applicants' teachings, Welter teaches mixing large iron particles of 20 microns to 40 microns (200,000 to 400,000 Angstrom) with magnesium chips, and then compacting the mixture. (Welter, column 3, lines 30-32) Welter further teaches that these iron particles are homogenously distributed over the surface of magnesium granulate particles. (Welter, column 4, lines 21-22) However, as shown in Appendix A of this response, the iron particles remain discrete particles and do not form a continuous or semi-continuous layers on the surface of the magnesium granulate particles.

As discussed in Welters, iron has very low solubility in magnesium. (Welters, column 2, lines 21-22) Forces that attract iron molecules to other iron molecules and forces that attract magnesium molecules to other magnesium molecules are much greater than the attractive forces between iron molecules and magnesium molecules. This difference in attraction levels results in the low solubility of iron in magnesium. Therefore, during a typical mixing and compacting process as taught by Welter, iron will not form a continuous or semi-continuous layer on magnesium, but rather, due to strong cohesive forces, iron will remain as large discrete particles. In fact, Welter only refers to iron particles and not layers (See Welter column 4, lines 21-22)

Applicants teach and claim a unique magnesium-based hydrogen storage material with a continuous or semi-continuous layer of catalyst material on the hydrogen storage alloy. Applicants teach that this continuous or semi-continuous layer can be achieved through, for example, a coating process which includes evaporating the catalytic material to coat the hydrogen storage alloy at a thickness of about 100 Angstrom (page 6, paragraph 58.) By providing this very thin coating of catalyst material on the hydrogen storage alloy, cohesion of the catalyst material is sufficiently weak to allow the catalyst material to be spread across the surface of the hydrogen storage alloy, but the cohesion of the catalyst material is sufficiently strong to provide a continuous or semi-continuous layer.

Since Welter does not teach a continuous or semi-continuous layer of catalytic material on the surface of the hydrogen storage alloy, as required by Applicants' claim 1, claim 1 along with claims 2, 4-5, 13-15, and 17-22, which are dependent on claim 1, are

not anticipated by Welter. Thus, Applicants respectfully request withdrawal of the rejection.

3. Rejection of Claims 1-2, 5, 13-22 under 35 U.S.C. 103 (a) over Fujii (*Hydrogen Storage Properties in Nano-Structured Magnesium and Carbon-related Materials*)

Applicants traverse the Examiner's rejection over Fujii, because Fujii does not teach a magnesium-based hydrogen storage material with a magnesium or magnesium-based hydrogen storage alloy which is in *bulk or particulate form*.

In contrast to Applicants' teachings, Fujii teaches a multi-layer Pd(50nm)/Mg(200) thin film form having up to seven layers. (page 78, column 2, second paragraph) Thus, as shown in Appendix A of this response, Fujii only teaches thin films with layers of palladium and magnesium, not continuous or semi-continuous coating of catalytic material on a bulk or particulate hydrogen storage alloy.

Fujii's only reference to bulk magnesium is when describing prior art hydrogen storage material where "the reaction is too slow and the desorption occurs at a rather high temperature above 570 K." (page 77, column 2) Fujii does not teach providing a continuous or semi-continuous layer of catalytic material on the surface of the bulk magnesium.

Since Fujii does not teach each element of Applicants claim 1, claim 1 along with claims 2, 5, 13-22, which are dependent on claim 1, are non-obvious in view of Fujii. Thus, applicants respectfully request withdrawal of the rejection.

4. **Rejection of Claims 1, 3-9, 13-15 and 17-22 under 35 U.S.C. 103 (a) over Oelerich et al. (*Metal Oxides as Catalysts for Improved Hydrogen Sorption in nanocrystalline Mg-based materials*)**

Applicants traverse the Examiner's rejection over Oelerich, because Oelerich teaches neither a magnesium or magnesium-based hydrogen storage alloy, nor a continuous or semi-continuous layer of catalytic material on the surface of the hydrogen storage alloy.

Magnesium-based or a Magnesium-Based Hydrogen Storage Alloy:

Applicants claim a "magnesium or a magnesium-based hydrogen storage alloy." In contrast to Applicants' claim 1, Derelict teaches a magnesium hydride compound or a magnesium nickel hydride compound (that is, a nano-crystalline hydride compound) (page 237, column 1 and page 238, column 2.)

In contrast, Applicants claim a magnesium or a magnesium based hydrogen storage alloy (that is, a homogenous mixture comprising magnesium) not a magnesium compound. Therefore, Oelerich does not teach this limitation claimed by the Applicants.

Continuous or Semi-continuous Layer of Catalytic Material:

Applicants further claim a continuous or semi-continuous layer of catalytic material on the surface of the hydrogen storage alloy. In contrast to Applicants' claim 1, Oelerich teaches utilizing metal oxides and non alloy H2 storage materials. As shown in Appendix A of this response, the system described in Oelerich would not produce the continuous or semi-continuous as claimed by applicants.

Oelerich teaches using metal oxides (CuO, Mn₂O₃, CrO, Fe₃O₄, and V₂O₅) not metal catalysts as taught by Applicants. (page 238, column 2) As mentioned above, the catalysts taught by Applicants have a certain cohesion level so that they can form a continuously or semi-continuously layer on the hydrogen storage alloy. The cohesive forces in the catalyst provide the property of malleability, that is, the property that allows the catalyst to be drawn out as a continuous or semi-continuous coating on the surface of the hydrogen storage alloy. The metal oxides discussed in Oelerich are not malleable and therefore, these metal oxides do not form continuously or semi-continuous layers on the hydrogen storage alloy.

Oelerich teaches a light weight, non-crystalline hydride material not the dense alloy material that is taught by applicants. (Oelerich page 237 column 2 – page 238 column 1 and page 238, column 2, paragraph 1). Oelerich provides no teaching or suggestion that Applicants continuous or semi-continuous layer could even be applied to this magnesium hydride based system.

Applicants agree with the Examiner that Oelerich does not specify that the surface would be continuous or semi-continuous. (Office Action, page 5)

However, Applicants disagree that one of ordinary skill in the art would expect at least a semi-continuous layer because sorption reaction kinetics would be sensitive to the surface composition of the magnesium-based alloy. (Office Action, page 5) As discussed previously, Oelerich teaches a different system (a light-weight, crystallite magnesium hydride compound based system) than Applicants' claimed system (a system having a magnesium or magnesium based alloy.) The light-weight magnesium hydride compounds described in Oelerich are not magnesium or magnesium based alloy claimed

by the Applicants. Therefore, one of ordinary skill in the art would expect several factors to contribute to sorption reaction kinetics between the two systems.

Since Oelerich does not teach each element, and in fact does not teach multiple elements, of Applicants claim 1, claim 1 along with claims 3-9, 13-15 and 17-22, which are dependent on claim 1, are non-obvious over Oelerich. Thus, Applicants respectfully request withdrawal of the rejection.

Applicants respectfully request withdrawal of all outstanding rejections and respectfully submit that the application stands in condition for allowance. If the Examiner has any questions or suggestions regarding this amendment, the Examiner is respectfully asked to contact Applicant's representative at the telephone number or email address listed below.

Respectfully submitted,

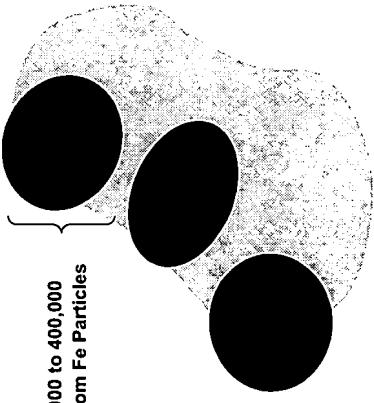
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Robert J. Svoboda

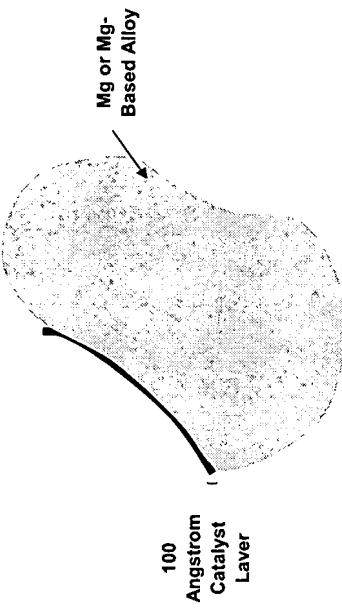
Reg. No. 58,135

Date: 11 April 2007
Energy Conversion Devices
2956 Waterview Drive
Rochester Hills, MI 48309
Phone: (248) 299-6052
Fax: (248) 844-2273

APPENDIX A

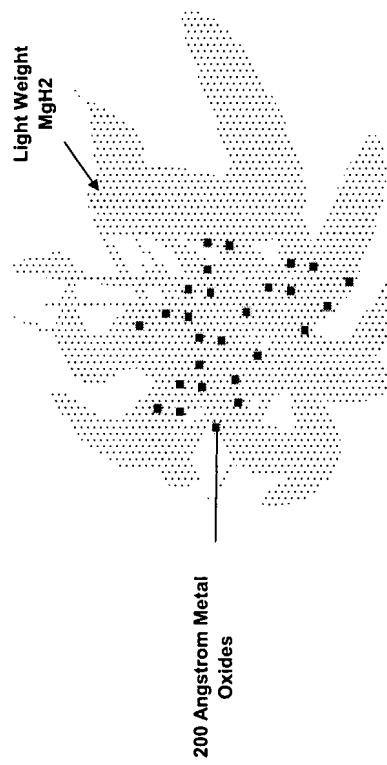


200,000 to 400,000
Angstrom Fe Particles



Present Application

Welter - 20 to 40 μm particles



200 Angstrom Metal
Oxides



Fujii - Thin Film

**Oelerich - Metal Oxide
Particles and Light Weight
MgH2**